ALBERTA ENVIRONMENT

WATER RESOURCES MANAGEMENT SERVICES

DESIGN AND CONSTRUCTION DIVISION

DESIGN BRANCH

WILLOW CREEK BASIN
PINE COULEE RESERVOIR
ALTERNATIVE 1 - OFFSTREAM STORAGE
CONCEPTUAL DESIGN REPORT

NOVEMBER 1985

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Prepared by: Chuyen Nguyen, P. Eng.

Pine Coulee Reservoir

Alternative 1 - Off-Stream Storage

Summary

This report presents the conceptual design on water storage in the Pine Coulee , an off-stream site identified for flow regulation in the Willow Creek Water Basin. The request for this design study was made by the Oldman River Basin Planner.

The Pine Coulee Reservoir is the only natural off-stream storage site identified during the planning study. Water can be stored in the coulee by a main embankment dam located at about the old PFRA site and a saddle dyke. Flow from the Willow Creek will be raised by a weir and conveyed to the reservoir through a high level diversion canal. The weir will be located approximately 950 m upstream of the Highway 527 bridge on Willow Creek, consisting of a concrete overflow section 42 m wide, a gated section 5.0 wide, an emergency overflow section 100 m wide and a built-in provision for fish passage. The diversion canal will require a 7 m bed width, 3:1 side slopes and 0.00018 bed grade, to carry a maximum discharge of about 500 cfs. The canal headgates will regulate the diverted flow and protect the canal works from Willow Creek floods. A

reservoir inlet of baffle apron type will assure a safe discharge of the diverted flow into the reservoir under all flow conditions.

In the reservoir area, coulee crossing of Highway 527 and the east/west section road along the north boundary of Township 14 will be raised above the reservoir full supply level. Existing culvert structures will be extended and upgraded to accommodate the two-way flow conditions. Approximately 8 km of roads will be relocated. Rock riprap protection will be provided at the upstream slope of the main dam, the saddle dyke and at both slopes of Highway 527 and east/west road coulee crossings.

At FSL (full supply level) of 1052.5 m (3,453 ft.) the Pine Coulee reservoir will store 40,000 ac ft or about 50 million m^3 and provide a water area of 1,460 acres (6.0 sq km). The flow regulation capability is about 58% of the mean annual runoff at the diverted site. Water uses from the reservoir can be made by gravity diversion, pumping and downstream release through a low level outlet located at the left bank of the main dam.

The project can be constructed in 3 calendar years. During the construction, flow of the Pine Coulee could be handled by the low level outlet. At the diversion weir site, the concrete section and the dyke

will be constructed first, on high ground. Closure of the creek bed will be made while diverting the creek flow through the completed concrete section.

The total project cost is revised at $29,500,000 including 15% contingencies as follows:

Construction Cost	$ 25,210,000
Site Cost	$ 890,000
Road Relocation	$ 700,000
Reservoir & Land	$ 2,700,000
Total	$ 29,500,000

This corresponds to about $737/acre feet.

The designs and cost estimates presented in this report are of conceptual nature and intended specifically to establish the order of magnitude costs and the general arrangement of the works. Considerable design works will be required before structural arrangement can be firmed up and details worked out.

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR
KEY PLAN

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1. Scope

This report serves as a final report on conceptual design of the Pine Coulee Reservoir within the context of the feasibility study of water storage of the Willow Creek basin.

2. Data and Information Available

- 1984 Preliminary Planning Study Report, provided by Planning Division.
- 1:5000 and 1:2000 Scale Contour Maps, provided by Survey Branch.
- Level I Hydrology Report and Natural Flow for Willow Creek Basin provided by Hydrology Branch.
- Minimum Freeboard Against Wave Run-up, provided by River Engineering.

3. Layout

The general layout is practically the same as proposed in the planning report, consisting of an embankment dam at Pine Coulee, a saddle dyke along the southeast periphery of the reservoir, a diversion weir on Willow Creek, a diversion canal complete with headgates and reservoir inlet, a major causeway at coulee crossing of Highway 527 and a minor causeway at the coulee crossing of E.W. section road, along north boundary of Tp. 14.

4. Reservoir Capacity and Area

At FSL 1052.5 m (3,453 ft), the reservoir provides a storage capacity of about 40,000 ac ft and a flooded area of about 1,460 acres.

5. Design Floods

The reservoir is classified as large in size and low in risk, according to the 1983 Dams and Canals Safety guidelines. The project flood selected for the embankment dam is 0.5 PMF. The estimated PMF at the dam site is 209 m^3/s in peak discharge and 532 m^3/s-days in volume. The construction flood selected for the embankment dam is of 1:25 yr frequency which is estimated at 5.9 m^3/s in peak discharge and 26.08 m^3/s-days in volume.

The diversion weir is classified as small in size and low in risk. The selected project flood is 0.3 PMF. The PMF estimated at the weir site is 1630 m^3/s in peak discharge and 4900 m^3/s-days in total volume. The construction flood selected for the diversion weir is the 1:25 yr flood, 159 m^3/s in peak discharge and 593.8 m^3/s-days in volume.

6. Upstream Slope Protection of Embankment Dam

The upstream slope of the main dam is subjected to waves and wave run-up generated by wind action. The 1 in 100 yr maximum hourly wind is used to establish the required size and thickness of the riprap material and bedding, and the wave surcharge.

7. Embankment Dam Freeboard

The crest elevation of the main dam and the saddle dyke is established by either the wave surcharge allowance or the project flood event, whichever is greater. In routing the project flood through the reservoir, the initial reservoir level is assumed at El. 1052.5 m. Preliminary analysis of waves surcharge and flood routing indicates a freeboard of about 1.7 m.

8. Embankment Dam

The main dam will have a 12 m wide crest at El. 1054.5 m. Both upstream and downstream slopes are 4:1 from the crest to a 50 m wide berm at El. 1043.3 m, and 8:1 from the berm to the valley floor. The dam crest is gravel lined and serves as relocated road.

9. Saddle Dyke

The saddle dyke has the same crest width as main dam and is gravel lined for relocated road purposes. Side slopes of the saddle dyke are 3:1. Riprap protection is provided on the dyke slope facing the reservoir.

10. Causeways

The Highway 527 coulee crossing is raised to at least 1.7 m above the reservoir FSL. The existing SPCSP culvert will be extended to suit the side slopes and provided with headwalls and granular protection to accommodate the two-way flow.

The E-W section road coulee crossing is raised to at least 1.4 m above the reservoir FSL. The existing culvert will be replaced with a gated CSP control structure to maintain a minimum permanent water body at the upstream side. Both causeways will be surfaced or subgraded and paved to meet the existing conditions.

11. Diversion Weir

The weir consists of a permanent overflow section, a dyke and an emergency overflow section. The permanent overflow section is sized to pass the project flood and to divert flow to the reservoir. A gated section, 5.0 m wide, will permit to lower the creek level and to pass the flow when diversion is not needed. Built-in space for fish passage is also provided. The emergency overflow section provides safety in case of flood events larger than the project flood.

12. Diversion Canal

The mean monthly flow during spring runoff at the diverson site is about 300 cfs. Willow Creek is subjected to high peak flows which occur during short period. The diversion canal should be able to carry a flow higher than the mean monthly flow otherwise the reservoir will not be filled during an average year. Higher reservoir level will create backwater in the canal resulting in a varied flow condition. The canal is best designed by the modified regime approach which requires a 7 m bed width, 3:1 side slopes and 0.00018 bed grade. The canal will carry a dominant flow of 300 cfs, a maximum flow of about 500 cfs. Headgates will protect the canal works from Willow Creek floods and a reservoir inlet structure of baffle apron type is required for safe discharge under a wide range of tailwater conditions in the reservoir.

13. Outlet Works

A low level outlet works is provided at the embankment dam to permit the diversion of flow during the construction, the regulation of the stored water and the release of flood flow originated from Pine Creek. Sizing of the conduit is governed by construction practicality and easy access for inspection and maintenance. Access shaft is of wet well type, provided with safety ladder, landing and air vent. The gate type and size are commercial products.

14. River Diversion During Construction

The design construction flood at the embankment dam site is estimated at 5.9 m^3/s in peak discharge which could be easily handled by the low level conduit. At the diversion weir site, the concrete overflow section and the dyke are constructed first on high ground. Closure of the creek bed will be done while diverting the creek flow through the completed gated opening of the overflow section.

15. Cost Estimates

The total project cost is estimated at $29,500,000 or $737/ac ft, consisting of site services cost, construction cost, road relocation, and reservoir cost, including a contingency provision of 15%.

16. Lower FSL Option

A lower FSL at elevation 1047.5 m is investigated. This option requires a minor saddle, few protection works at Highway 527 crossing of Pine Coulee and a shorter diversion canal. Storage capacity is reduced to about 20,000 ac ft. This option is costed at $18,500,000 or $952 per acre-feet stored.

17. Pump-in Option

The pump-in option consists of a retention sheet piling rock weir at the PFRA proposed dam site on the Willow Creek, a pump station, discharge pipes, outflow structure, conveyance canal and reservoir inlet structure. Construction cost is estimated at $8,000,000. Cost summaries are attached. Since the Willow Creek high flows are of short duration, the pump-in option is not recommended.

18. Buried Conduit vs. Open Diversion Canal Option

The buried conduit could be either cast-in-place or precast. The cost is more than twice the open canal cost. This option is not pursued further.

19. Pine Coulee On-stream Site Option

A site on the Willow Creek immediately downstream of the Pine Coulee junction will provide an option capable of storing most run-off available at this site, in an average year. This option, designated as Alternative 2 On-stream Storage, will be reported separately.

PINE COULEE RESERVOIR

SITE 2

COST SUMMARY

A)	Site Services	$ 980,000
B)	Diversion Weir	$ 3,450,000
C)	Headgates	$ 250,000
D)	Diversion Channel	$ 2,182,000
E)	Reservoir Inlet	$ 327,000
F)	Dam Embankment	$ 8,922,000
G)	Outlet Works	$ 1,420,000
H)	Saddle Dyke	$ 4,410,000
I)	Causeway @ Highway #527	$ 3,580,000
J)	Causeway @ E-W Road (N.Bdy. of 33-14-28-w4)	$ 572,000
K)	Road Relocation	$ 700,000
L)	Reservoir	$ 2,700,000
	Total	$ 29,493,000
	Say	$ 29,500,000

COST ITEM

A)	Site Services			
1)	Performance Bond	L.S.	$	80,000
2)	Labour & Materials Bond	L.S.	$	40,000
3)	Construction Camp & Office	L.S.	$	200,000
4)	Construction Roads	5 km @ $25,000	$	125,000
5)	Powerlines	10 km @ $20,000	$	200,000
6)	Utilities	L.S.	$	50,000
7)	Surface Drainage	L.S.	$	50,000
8)	Landscaping	L.S.	$	50,000
9)	Miscellaneous		$	50,000
			$	845,000
		x 1.15 =	$	971,750
		Say	$	980,000

B) Diversion Weir

1)	Mobilization & Demobilization	L.S.	$ 100,000
2)	Care of Water	L.S.	$ 150,000
3)	Common Excavation	228,000 m^3 @ $1.6	$ 364,800
4)	Structural Excavation	1,000 m^3 @ $3.0	$ 3,000
5)	Compacted Impervious Fill	53,000 m^3 @ $1.00	$ 53,000
6)	Tamped Impervious Backfill	1,000 m^3 @ $5.00	$ 5,000
7)	Riprap	6,700 m^3 @ $50.00	$ 335,000
8)	Coarse Filter	2,300 m^3 @ $15.00	$ 34,500
9)	Fine Filter	1,100 m^3 @ $18.00	$ 19,800
10)	Drain Gravel	4,400 m^3 @ $20.00	$ 88,000
11)	Topsoil & Seeding	4.7 Ha @ $7000.0	$ 32,900
12)	Sheet Piling	500 m^2 @ 200.0	$ 100,000
13)	Lean Concrete	140 m^3 @ 200.0	$ 28,000
14)	Reinforced Concrete	4,100 m^3 @ $350.0	$1,435,000
15)	Gate & Hoist, 5000 x 4000 mm Radial Gate	1 Unit @ $100,000	$ 100,000
16)	Fish Pass	L.S.	$ 50,000
17)	Miscellaneous		$ 100,000
			$2,999,000
		x 1.15	$3,448,850
		Say	$3,450,000

C) Headgates

1)	Structural Excavation	300 m^3 @ $3.0	$ 900
2)	Compacted Impervious Fill	3900 m^3 @ $1.00	$ 3,900
3)	Tamped Impervious Backfill	1300 m^3 @ $5.00	$ 6,500
4)	Riprap	700 m^3 @ 50.0	$ 35,000
5)	Coarse Filter	400 m^3 @ $15.00	$ 6,000
6)	Fine Filter	200 m^3 @ $18.00	$ 3,600
7)	Drain Gravel	200 m^3 @ $20.00	$ 4,000
8)	Road Gravel	10 m^3 @ $10.0	$ 100
9)	Lean Concrete	10 m^3 @ $200.0	$ 2,000
10)	Reinforced Concrete	250 m^3 @ $400.0	$100,000
11)	Gates & Hoists, 72" x 96" Sluice Gate	3 Units @ $10,000	$ 30,000
12)	Miscellaneous		$ 25,000
			$217,000
		x 1.15 =	$249,550
		Say	$250,000

D) Diversion Channel

1)	Common Excavation	790,500 m^3 @ $1.60	$1,264,800
2)	Compacted Impervious Fill	82,000 m^3 @ 1.00	$ 82,000
3)	Gravel Liner	16,000 m^3 @ $10.00	$ 160,000
4)	Road Gravel	1,600 m^3 @ $10.00	$ 16,000
5)	Topsoil & Seeding	3.50 Ha @ $7,000	$ 24,500
6)	Cross Drainage	2 Units @ $50,000	$ 100,000
7)	Bridge	200 m^2 @ $1,000	$ 200,000
8)	Fencing		$ 20,000
9)	Miscellaneous		$ 30,000
			$1,897,300
		x 1.15 =	$2,181,895
		Say	$2,182,000

E) Reservoir Inlet

1)	Structural Excavation	7,200 m^3 @ $3.0	$ 21,600
2)	Tamped Impervious Fill	2,100 m^3 @ $5.0	$ 10,500
3)	Riprap	100 m^3 @ $50.0	$ 10,000
4)	Coarse Filter	860 m^3 @ $15.00	$ 12,900
5)	Fine Filter	620 m^3 @ $18.00	$ 11,160
6)	Lean Concrete	65 m^3 @ $200	$ 13,000
7)	Reinforced Concrete	450 m^3 @ $400	$180,000
8)	Miscellaneous		$ 25,000
			$284,160
		x 1.15 =	$326,784
		Say	$327,000

F) Dam Embankment

1)	Mobilization & Demobilization	L.S.	$ 400,000
2)	Care of Water	L.S.	$ 50,000
3)	Common Excavation	1,248,300 m^3 @ $1.60	$1,997,280
4)	Compacted Impervious Fill	1,021,100 m^3 @ $1.00	$1,021,100
5)	Coarse Filter	94,200 m^3 @ $15.00	$1,413,000
6)	Fine Filter	90,800 m^3 @ $18.00	$1,634,400
7)	Pitrun Gravel	13,400 m^3 @ $8.00	$ 107,200
8)	Riprap	13,350 m^3 @ $50.00	$ 667,500
9)	Road Gravel	550 m^3 @ $10.00	$ 5,500
10)	Topsoil & Seeding	6.4 Ha @ $7000.00	$ 44,800
11)	Wick Drain	L.S.	$ 232,000
12)	Instrumentation	L.S.	$ 35,000
13)	Road Guardrail	L.S.	$ 50,000
14)	Miscellaneous		$ 100,000
			$7,757,780
		x 1.15	$8,921,447
		Say	$8,922,000

G) Outlet Works

1)	Common Excavation	78,100 m^3 @ $1.6	$ 124,960
2)	Structural Excavation	10,800 m^3 @ $3.0	$ 32,400
3)	Tamped Impervious Backfill	7,800 m^3 @ $5.00	$ 39,000
4)	Riprap	200 m^3 @ $50.00	$ 10,000
5)	Coarse Filter	200 m^3 @ $15.00	$ 3,000
6)	Fine Filter	150 m^3 @ $18.00	$ 2,700
7)	Lean Concrete	45 m^3 @ $200.0	$ 9,000
8)	Reinforced Concrete	2,000 m^3 @ $350	$ 700,000
9)	Bituminous Paint	L.S.	$ 30,000
10)	Gate & Lift - 60" x 84" Sluice Gate	1 Unit @ $50,000	$ 50,000
11)	Air Vent	L.S.	$ 20,000
12)	Safety Ladder	L.S.	$ 60,000
13)	Metal Building	L.S.	$ 100,000
14)	Miscellaneous		$ 50,000
			$1,231,060
		x 1.15 =	$1,415,719
		Say	$1,420,000

H) Saddle Dyke

1)	Common Excavation	651,000 m^3 @ $1.60	$1,041,600
2)	Compacted Impervious Fill	473,000 m^3 @ $1.00	$ 473,000
3)	Riprap	29,000 m^3 @ $50.00	$1,450,000
4)	Pitrun Gravel	37,000 m^3 @ $8.00	$ 296,000
5)	Coarse Filter	19,000 m^3 @ $15.00	$ 285,000
6)	Fine Filter	9,000 m^3 @ $18.00	$ 162,000
7)	Road Gravel	3,400 m^3 @ $10.0	$ 34,000
8)	Topsoil & Seeding	3.5 Ha @ $7,000	$ 24,500
9)	Road Guardrail	L.S.	$ 15,000
10)	Miscellaneous		$ 50,000
			$3,831,100
		x 1.15 =	$4,405,765
		Say	$4,410,000

I) Causeway @ Highway # 527

1)	Mobilization & Demobilization	L.S.	$ 100,000
2)	Traffic Detour & Control	L.S.	$ 50,000
3)	Common Excavation	334,000 m^3 @ $1.60	$ 534,400
4)	Compacted Impervious Fill	261,000 m^3 @ $1.00	$ 261,000
5)	Road Subbase & Pavement	L.S.	$ 42,000
6)	Riprap	19,000 m^3 @ $50.00	$ 950,000
7)	Coarse Filter	29,000 m^3 @ $15.00	$ 435,000
8)	Fine Filter	23,500 m^3 @ $18.00	$ 423,000
9)	Pitrun Gravel	10,600 m^3 @ $8.00	$ 84,800
10)	Wick Drain	L.S.	$ 100,000
11)	SPCSP Extended & Up-graded	L.S.	$ 50,000
12)	Road Guardrail	L.S.	$ 30,000
13)	Miscellaneous		$ 50,000
			$3,110,200
		x 1.15 =	$3,576,730
		Say	$3,580,000

J) Causeway @ EW Road - North Boundary of 33-14-28-W4

1)	Traffic Detour & Control	L.S.	$ 20,000
2)	Common Excavation	37,500 m^3 @ $1.60	$ 60,000
3)	Compacted Impervious Fill	27,500 m^3 @ $1.00	$ 27,500
4)	Riprap	3,730 m^3 @ $50.0	$ 186,500
5)	Coarse Filter	2,850 m^3 @ $15.00	$ 42,750
6)	Fine Filter	1,700 m^3 @ $18.00	$ 30,600
7)	Road Sub-base & Pavement	L.S.	$ 30,000
8)	Gated CSP Structure	L.S.	$ 60,000
9)	Road Guardrail	L.S.	$ 20,000
10)	Miscellaneous		$ 20,000
			$ 497,350
		x 1.15 =	$ 571,953
		Say	$ 572,000

K) Road Relocation

1)	Traffic Detour & Control	L.S.	$ 50,000
2)	Upgraded Gravel Road	3.3. km @ $40,000	$ 132,000
3)	New Gravel Road	4.8 km @ $60,000	$ 288,000
4)	Fencing	9,600 m @ $3.0	$ 28,000
5)	Traffic Sign	L.S.	$ 10,000
6)	Miscellaneous		$ 50,000
			$ 558,800
		x 1.15 =	$ 642,620
		Say	$ 700,000

L) Reservoir

1)	Reservoir Clearing	600 Ha @ $1,000	$ 600,000
2)	Rim Stabilization	L.S.	$ 200,000
3)	Cultivated Dry Land	140 Ac @ $1,000	$ 140,000
4)	Range Pasture	700 Ac @ $500	$ 350,000
5)	Valley Walls	140 Ac @ $300	$ 42,000
6)	Large Farmstead	1 Unit @ $400,000	$ 400,000
7)	Medium Farmstead	1 Unit @ $200,000	$ 200,000
8)	Small Farmstead	3 Units @ $50,000	$ 150,000
9)	Wells	L.S.	$ 30,000
10)	Refencing	L.S.	$ 50,000
11)	Miscellaneous		$ 50,000
			$2,212,000
		x 1.15 =	$2,543,800
		Say	$2,700,000

Pump in Option

Conceptual Cost Estimates

Cost Summary

Construction Costs	
Pump Station	$ 2,000,000
Pumps & Motors (1)	$ 4,300,000
Weir	$ 900,000
Conveyance	$ 800,000
	$ 8,000,000

(1) Pump Capacity

3 Units @ 52,500 USGPM (U.S. gallon per minute)

Total Capacity $10m^3/s$ (350 cfs)

COST ITEMS

Pump Station

1)	Mobilization & Demobilization	L.S.	$ 200,000
2)	Care of Water	L.S.	$ 100,000
3)	Excavation	50,000 m^3 @ $3.0	$ 150,000
4)	Backfill	30,000 m^3 @ $2.0	$ 40,000
5)	H Piles	1,200 m @ $150	$ 180,000
6)	Reinforced Concrete	900 m^3 @ $350	$ 315,000
7)	Discharge Pipelines	210 m @ $1,500	$ 315,000
8)	Miscellaneous		$ 200,000
			$1,500,000
		x 1.3	$2,000,000
			$2,000,000

Pumps & Motors

1)	Pumps & Electric Motors USGPM 52500, Supply & Installation (Supply = 400,000) (Installation = 100,000)	3 Units @ $500,00	$1,500,000
2)	Valves & Control	L.S.	$ 500,000
3)	Internal Electrical Switch Gear	L.S.	$ 200,000
4)	Powerline & Sub-station	L.S.	$ 300,000
5)	Building & Hoist	L.S.	$ 300,000
6)	Miscellaneous		$ 500,000
			$3,300,000
		x 1.3	$4,300,000

Weir

1)	Care of Water	L.S.	$ 100,000
2)	Excavation	12,000 m^3 @ $3.0	$ 36,000
3)	Backfill	4,000 m^3 @ $2.0	$ 8,000
4)	Sheet Piling	700 m^2 @ $300	$ 210,000
5)	Riprap & Bedding	8,000 m^3 @ $20.0	$ 160,000
6)	Reinforced Concrete	280 m^3 @ $350	$ 98,000
7)	Miscellaneous		$ 100,000
			$ 712,000
		x 1.3 =	$ 900,000

Conveyance Channel

1)	Outflow Structure	L.S.	$ 100,000
2)	Excavation	65,000 m^3 @ $1.5	$ 97,500
3)	Gravel Liner	5,000 m^3 @ $10	$ 50,000
4)	Reservoir Inlet	Reported	$ 300,000
5)	Miscellaneous		$ 60,000
			$ 607,500
		x 1.3 =	$ 800,000

PERTINENT DATA

1)	Reservoir		
	Project Flood	0.5 PMF	
	FSL	1052.5 m	(3,453 ft)
	Storage at FSL	40,000 ac. ft.	
	Reservoir Area at FSL	1460 acres	
2)	Embankment Dam		
	Crest Elevation	1054.5 m	(3,459.6 ft)
	Crest Length	450 m	(1,476 ft)
	Maximum Height	21.0 m	(69 ft)
	Composite Side Slopes	4:1 & 8:1	

3) Diversion Weir

Projected Flood	0.3 PMF	
Overall Length	605 m	(1985 ft)
Overflow Section		
Width	42 m	(138 ft)
Length	47.50 m	(156 ft)
Drop	9.75 m	(32 ft)
Gated Section		
Width	5.00 m	(16.40 ft)
Gate Type & Size	Radial Type 5,000 x 4,000 mm	
Fish Passage		
Width	2.25 m	
Gate Type & Size	Sluice Gate 36" x 96"	
Dyke		
Crest Elevation	1056.5 m	
Crest Width	4.5 m	
Side Slopes	2:1 U/S - 3:1 D/	
Emergency Overflow		
Width	100 m	(328 ft)

4) Low Level Outlet

Intake Elevation	1035 m	
Conduit Size		
- Upstream	1.5 X 2.5 m	
- Downstream	1.5 x 2.13 m	
Gate	60" x 84" Sluice Gate	
Gate Well	Wet Type	

5) Diversion Canal

Length	3,000 m	(9843 ft)
Bottom Width	7.0 m	(23 ft)
S/S	3:1	
Bed Grade	0.00018	
Bank Height	2.75 m	(9 ft)

6) Saddle Dyke

Length	2940 m
Height	
Maximum	12 m
Average	7 m

Proposed Unit Costs

A. Site Services Cost

1)	Performance Bond	0.4% of Contract Cost
2)	Labour & Material Bond	0.2% of Contract Cost
3)	Construction Road	$ 25,000/km
4)	Powerline	$ 20,000/km

B. Damages & Mitigations Cost

1)	Reservoir Cleaning	$ 1,000/Ha
2)	Road Location:	
	- Trail Upgraded	$ 40,000/km
	- New Location	$ 60,000/km
3)	Cultivated Dry Land	$ 1,000/ac
4)	Range Pasture	$ 500/ac
5)	Valley Walls	$ 300/ac
6)	Large Farmstead	$400,000/farm
7)	Medium Farmstead	$200,000/farm
8)	Small Farmstead	$ 50,000/farm

C. Contingencies

1)	Level I Estimates	15%
2)	Level II Estimates	10%

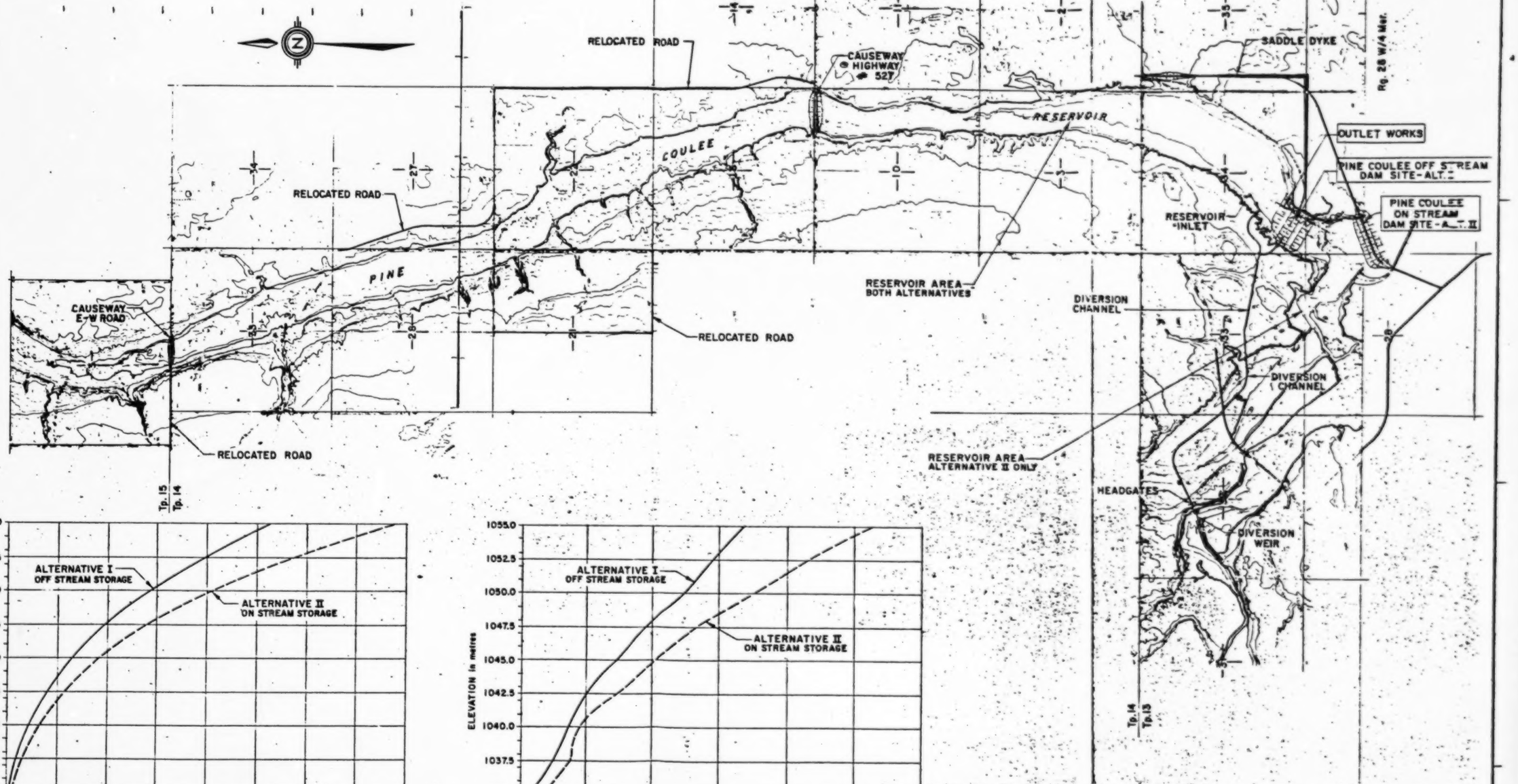
D. Engineering Fees/Cost

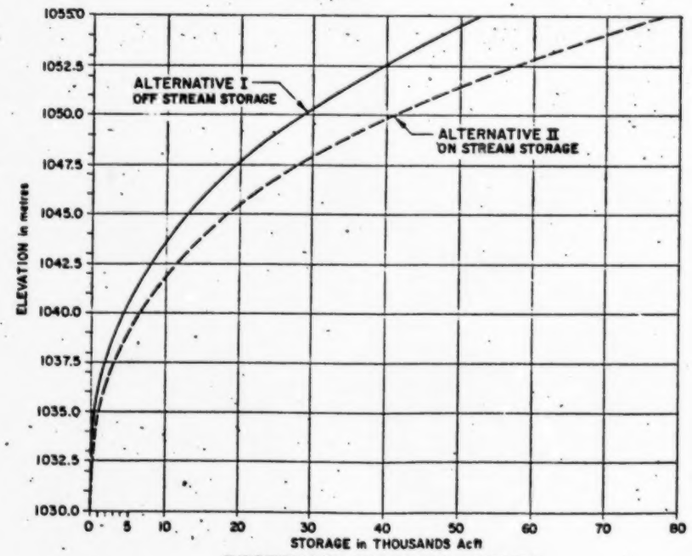
1)	Up to Contract Stage	10-15% of Contract Cost
2)	Turnkey	20% of Contract Cost

E. Construction Cost

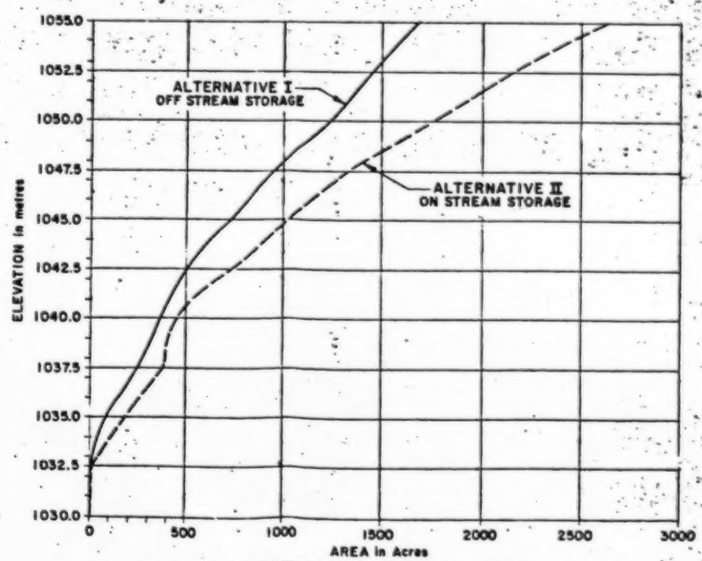
1)	Stripping	$ 1.6/m^3
2)	Common Excavation	$ 1.6/m^3
3)	Structural Excavation	$ 3.0/m^3
4)	Rock Excavation	$10.0/m^3
5)	Compacted Impervious Fill (From Excavated Material)	$ 1.00/m^3
6)	Tamped Impervious Backfill	$ 5.00/m^3
7)	Drain & Blanket	$ 20.0/m^3
8)	Gravel Liner	$ 10.0/m^3
9)	Road Gravel	$ 10.0/m^3
10)	Pitrun Gravel	$ 8.0/m^3
11)	Riprap	$ 50.0/m^3
12)	Coarse Filter	$ 15.0/m^3
13)	Fine Filter	$ 18.0/m^3
14)	Topsoil & Seeding	$ 7,000/Ha
15)	Steel Sheet Piling	$ 200/m^2
16)	Fencing	$ 3.0/m
17)	Lean Concrete	$ 200/m^3
18)	Reinforced Concrete (included re-bars)	
	- Spillway, Weir, Outlet Works	$ 350/m^3
	- Other Structures	$ 400/m^3
19)	- Slurry Trench, 3.0 m Thick	$ 100/m^2
20)	- Mobilization & Demobilization for Slurry Trench - L.S.	$ 100,000

MICROFILM DATE
DRAWING FILE No. PICOR 4885
CENTRAL FILE No.





RESERVOIR STORAGE CURVES



RESERVOIR AREA CURVES

MARK	NATURE OF REVISION	DATE	ENG.	DWN.
1				
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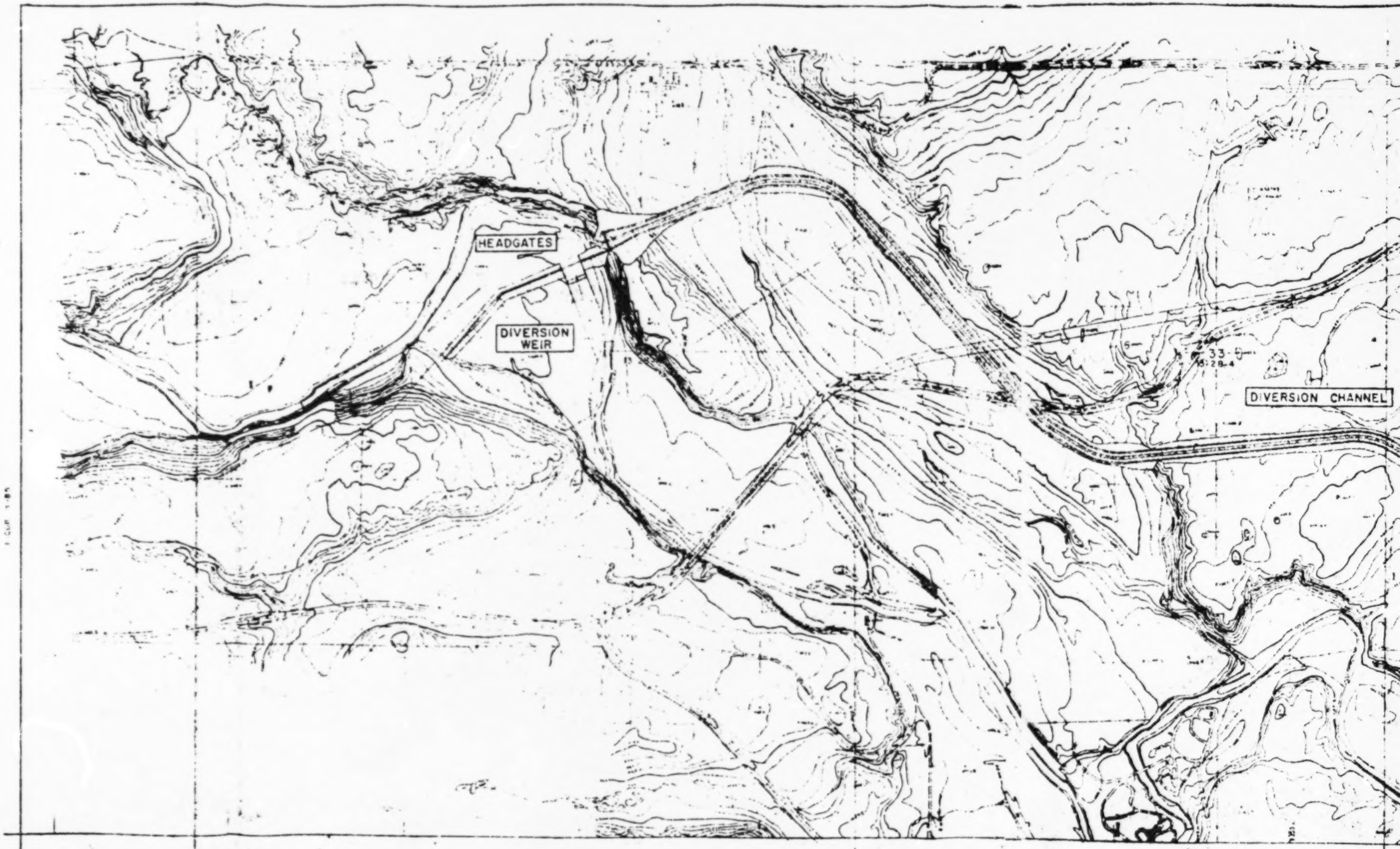
Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED ..... DATE	DESIGNED ..... CHECKED .....
APPROVED ..... DATE	DRAWN ..... CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR - OFFSTREAM STORAGE

RESERVOIR AREA

SCALE 1:20 000	SHEET 1 OF 9
DATE AUGUST, 1985	DWG No PICOR - E85-48


HEADGATES
DIVERSION WEIR
DIVERSION CHANNEL

BORROW AREA

SADDLE DYKE

DIVERSION CHANNEL

RESERVOIR INLET

PINE COULEE DAM

OUTLET WORKS

33

34

N

Alberta ENVIRONMENT WATER RESOURCES DESIGN AND CONSTRUCTION DIVISION

DESIGNED

CHECKED

DRAWN

APPROVED

DATE

SCALE

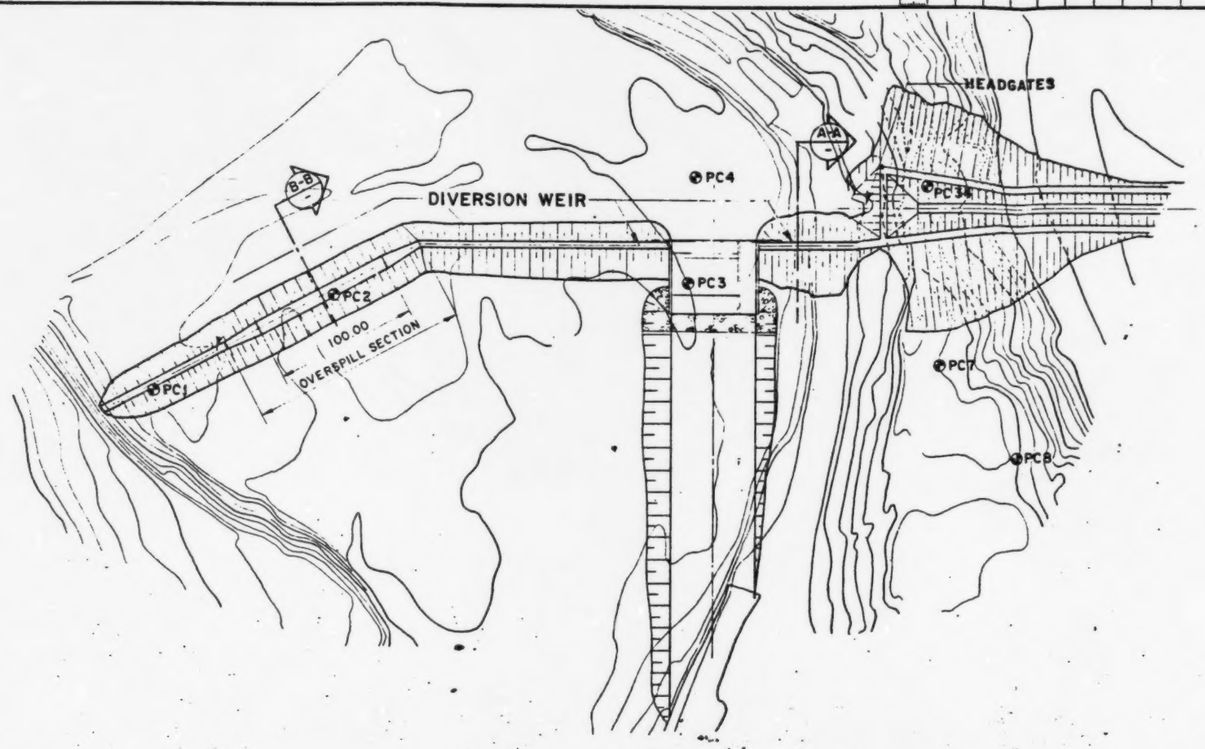
AS A CHECK PROJECT

PINE COULEE RESERVOIR - OFFSTREAM STORAGE

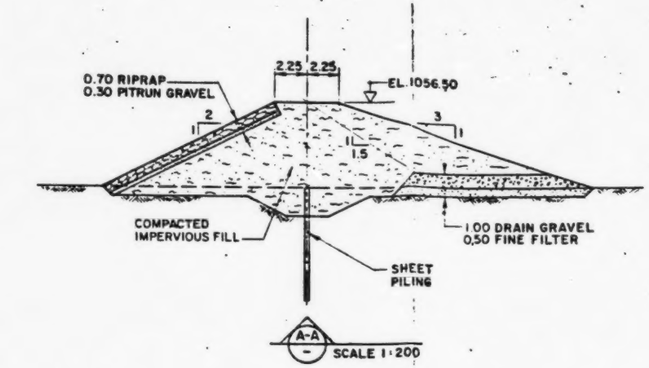
SITE PLAN

SHEET 2 OF 19

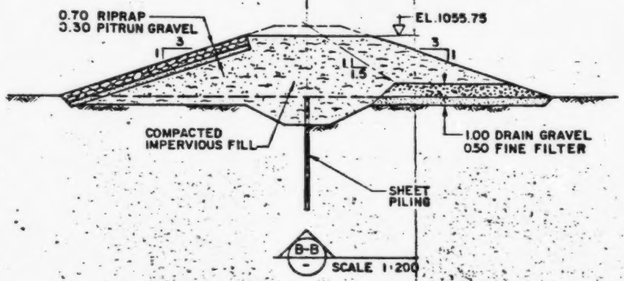
MICROFILM DATE
DRAWING FILE No. PICOR 3085
CENTRAL FILE No.



PLAN
SCALE 1:2000



A-A
SCALE 1:200



B-B
SCALE 1:200

MARK	NATURE OF REVISION	DATE	ENG.	DWN.
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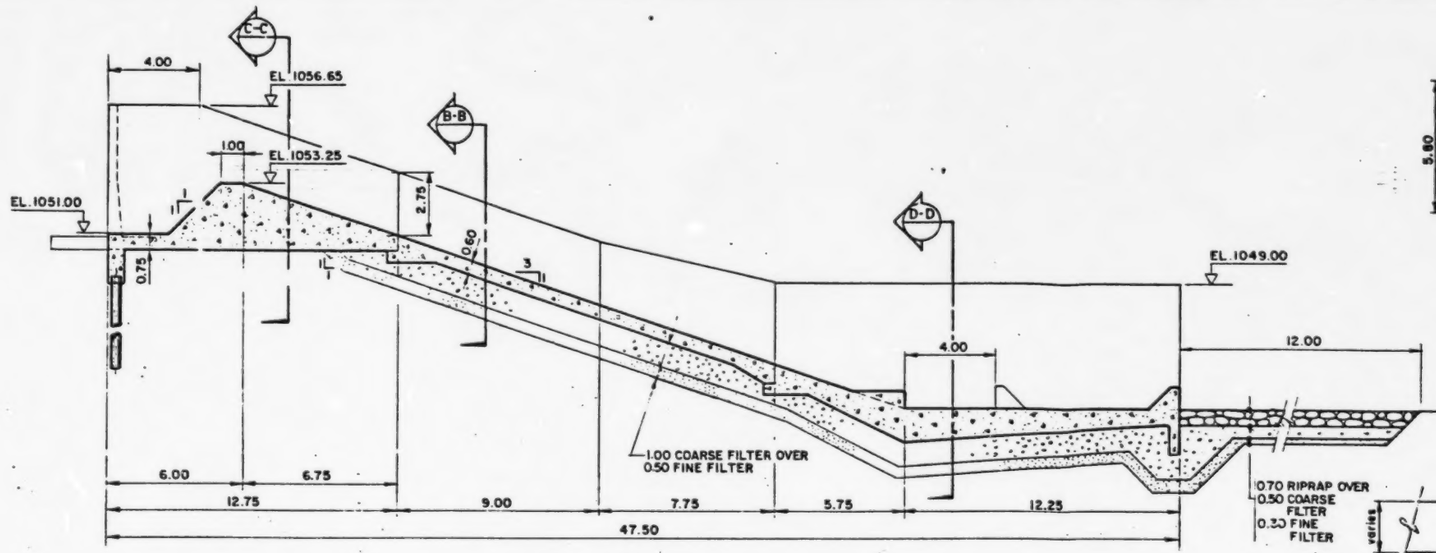
Alberta ENVIRONMENT DESIGN AND CONSTRUCTION DIVISION

SUBMITTED ..... DATE	DESIGNED ..... CHECKED .....
APPROVED ..... DATE	DRAWN ..... CHECKED .....

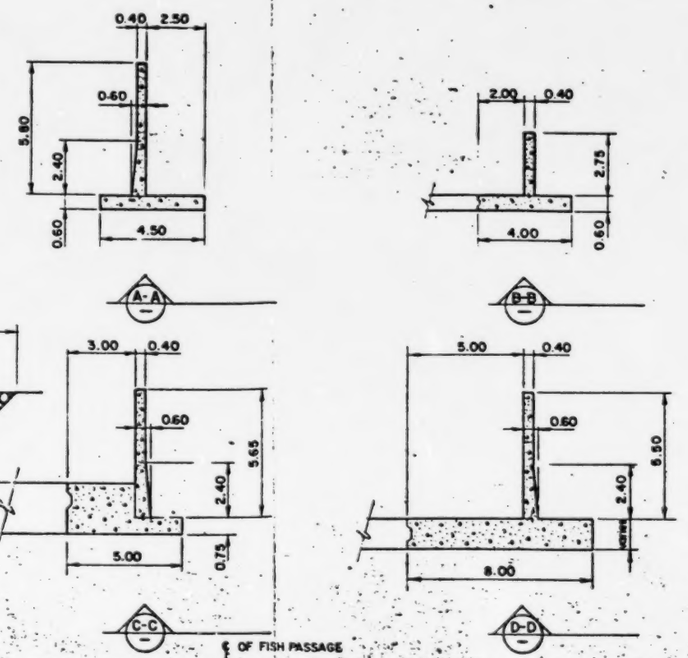
WILLOW CREEK PROJECT
PINE COULEE RESERVOIR - OFFSTREAM STORAGE
DIVERSION WEIR
GENERAL ARRANGEMENT

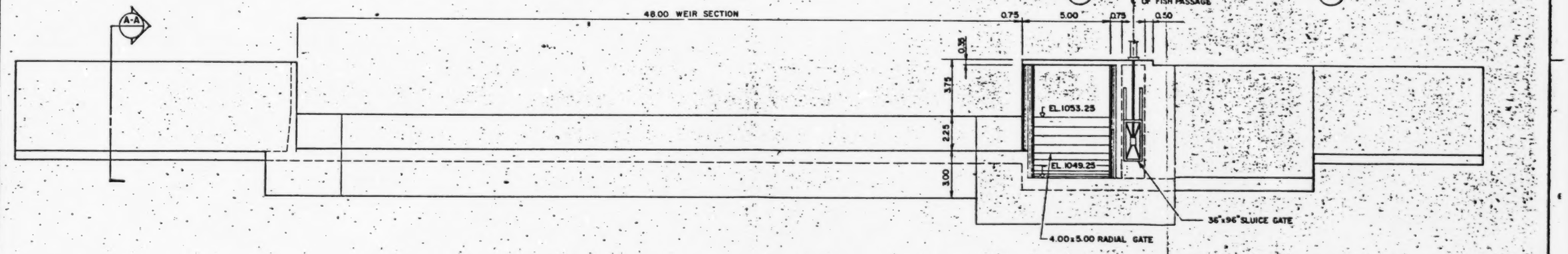
SCALE AS SHOWN	SHEET 3 OF 9
DATE SEPTEMBER, 1985	DWG No PICOR-E 85-50

MICROFILM DATE
DRAWING FILE NO. PICOR-E85-31
CENTRAL FILE NO.



℄ WEIR SECTION





FRONT ELEVATION

MARK	NATURE OF REVISION	DATE	ENG.	DWN.
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Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

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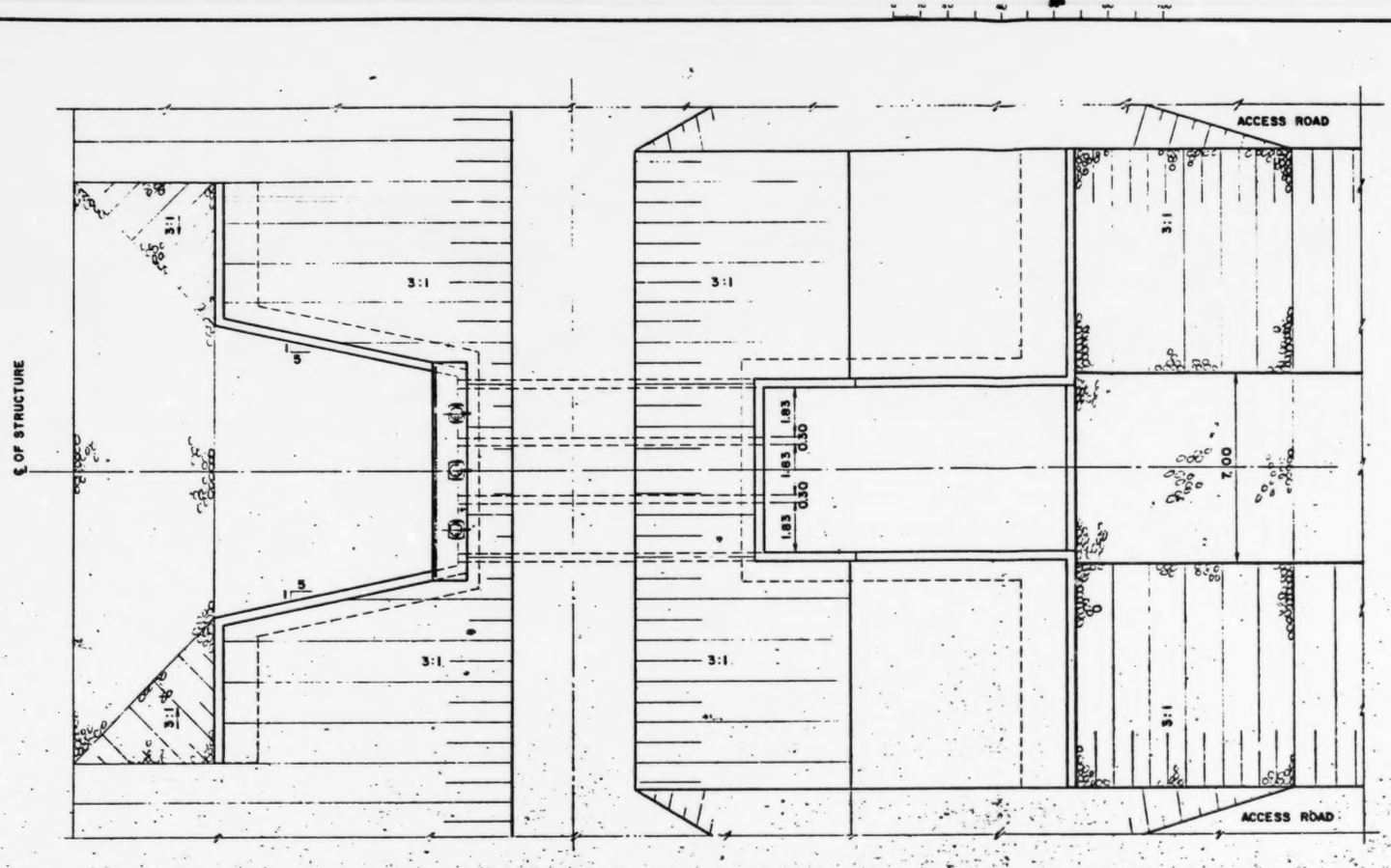
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

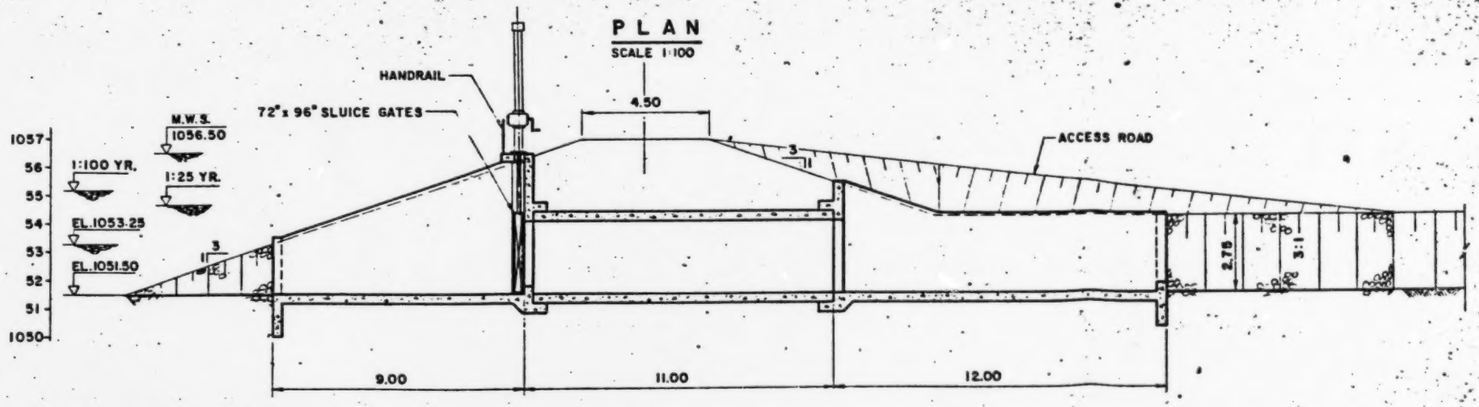
WILLOW CREEK PROJECT
PINE COULEE RESERVOIR - OFFSTREAM STORAGE

DIVERSION WEIR - ELEVATION & SECTIONS

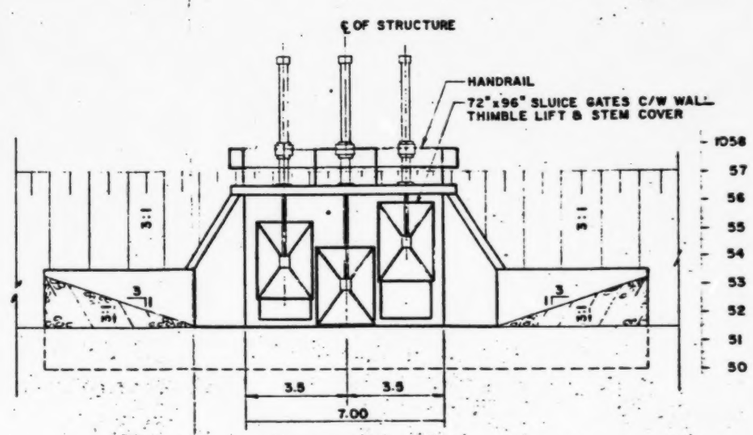
SCALE 1:125	SHEET 4 OF 9
DATE AUGUST, 1985	DWG No PICOR - E85 - 31



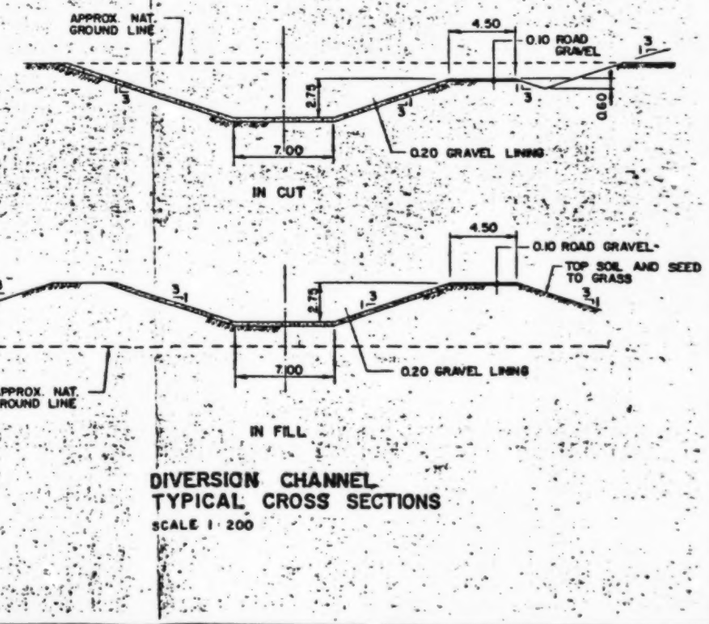
PLAN
SCALE 1:100



CENTRE LINE SECTION
SCALE 1:100



UPSTREAM ELEVATION
SCALE 1:100



DIVERSION CHANNEL
TYPICAL CROSS SECTIONS
SCALE 1:200

MARK	NATURE OF REVISION	DATE	ENG.	DWN.
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Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

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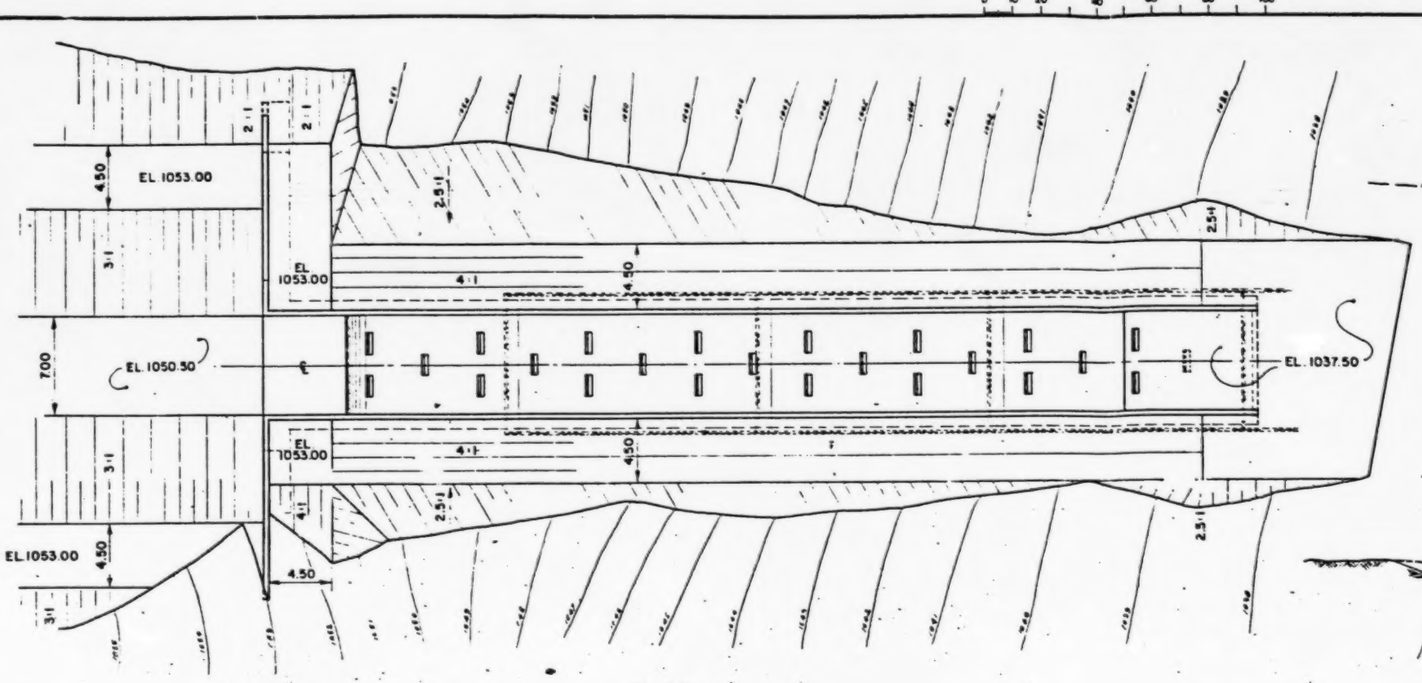
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR - OFFSTREAM STORAGE

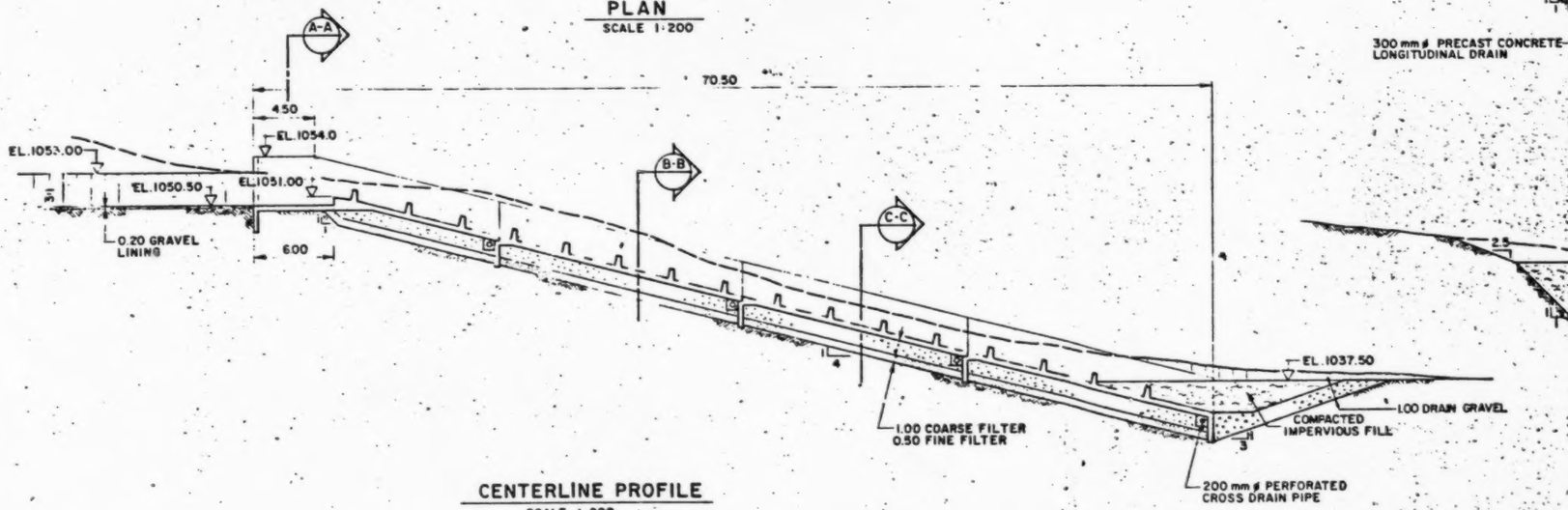
HEAD GATES AND DIVERSION CHANNEL

SCALE AS SHOWN	SHEET 5 OF 9
DATE AUGUST, 1985	DWG. No. PICOR - E85 - 52

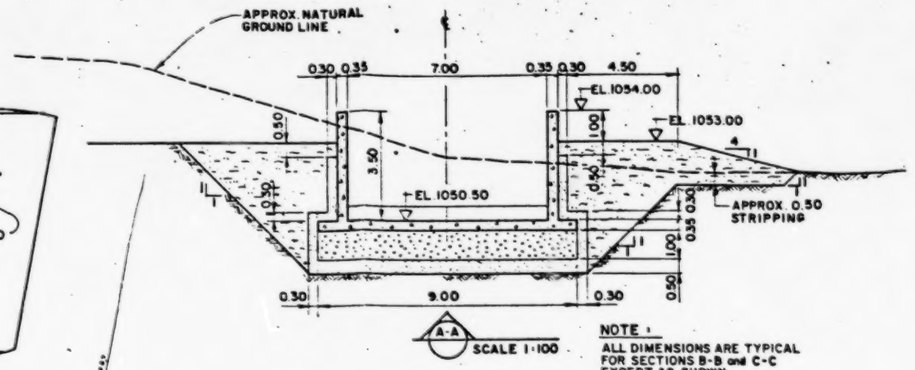
MICROFILM DATE
CENTRAL FILE No.
DRAWING FILE No. PICOR 8385



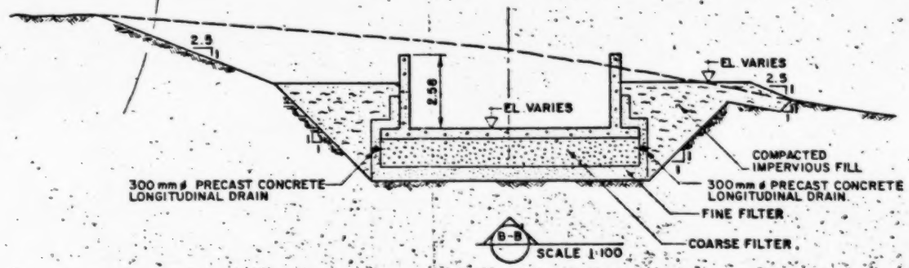
PLAN
SCALE 1:200

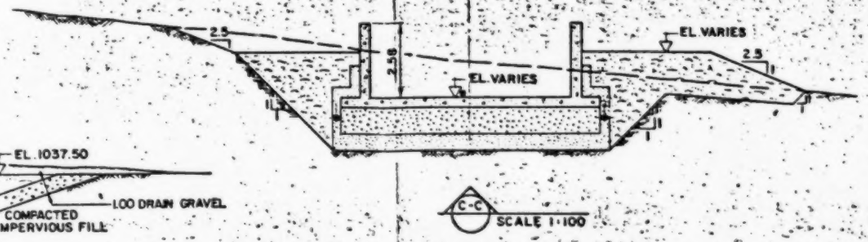


CENTERLINE PROFILE
SCALE 1:200



NOTE :
ALL DIMENSIONS ARE TYPICAL FOR SECTIONS B-B and C-C EXCEPT AS SHOWN





MARK	NATURE OF REVISION	DATE	ENG	DWN
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Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED .....
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR – OFFSTREAM STORAGE

RESERVOIR INLET

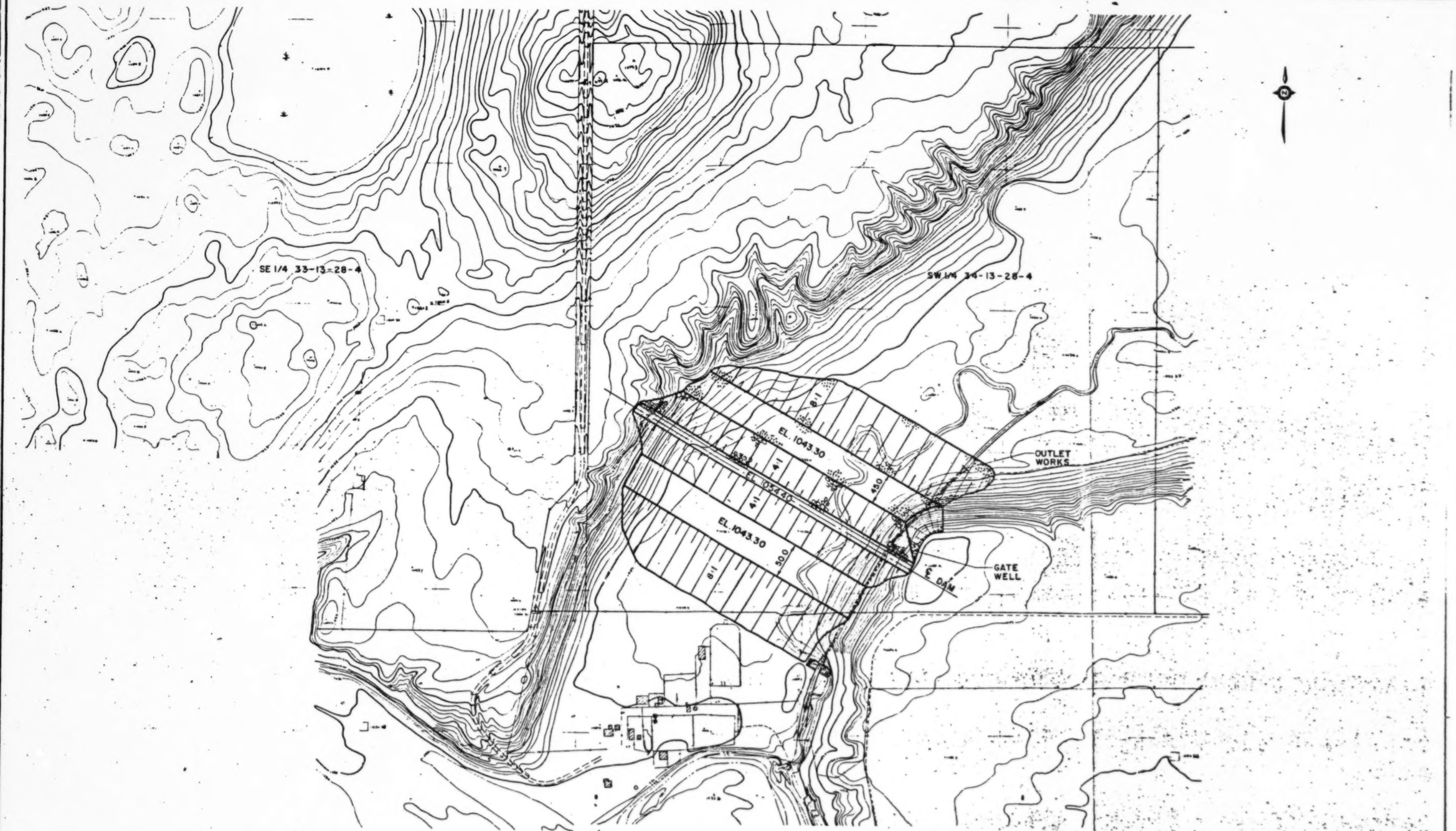
SCALE AS SHOWN	SHEET 6 OF 9
DATE SEPTEMBER	DWG No. PICOR-E85-53

P1-560 x 860 M-F

MICROFILM DATE

DRAWING FILE No PICOR 5485

CENTRAL FILE No



MARK	NATURE OF REVISION	DATE	ENG	DWN
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Alberta ENVIRONMENT

SUBMITTED	DESIGNED
DATE	CHECKED
APPROVED	DRAWN
DATE	CHECKED

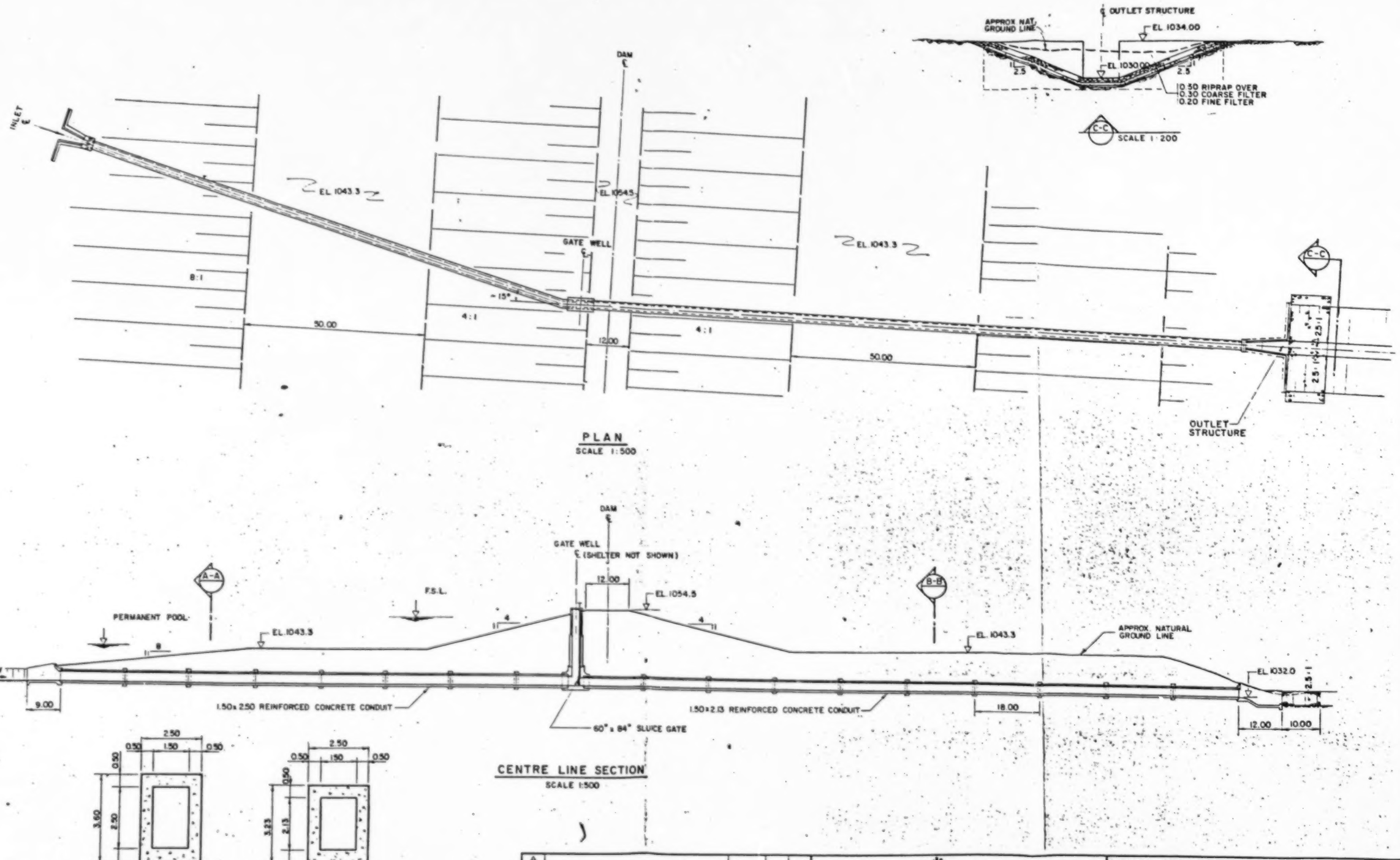
WILLOW CREEK PROJECT

PINE COULEE RESERVOIR - OFFSTREAM STORAGE

DAM EMBANKMENT AND OUTLET WORKS

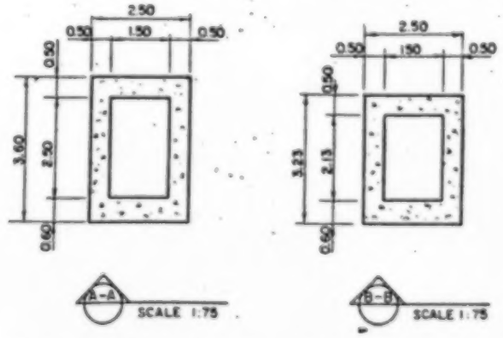
SCALE 1:2500	SHEET 7 OF 9
DATE SEPT., 1985	DWG No PICOR-E85-54

MICROFILM DATE
DRAWING FILE No. PICOR 3585
CENTRAL FILE NO



PLAN
SCALE 1:500

CENTRE LINE SECTION
SCALE 1:500



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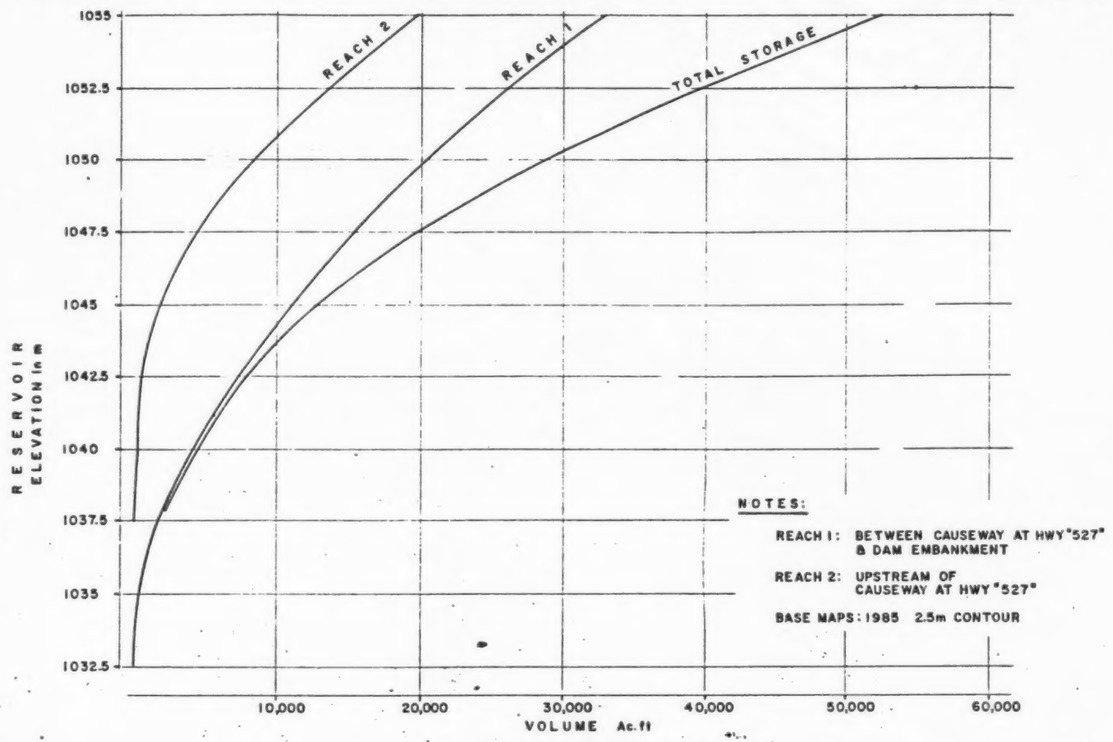
Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED
DATE	CHECKED
APPROVED	DRAWN
DATE	CHECKED

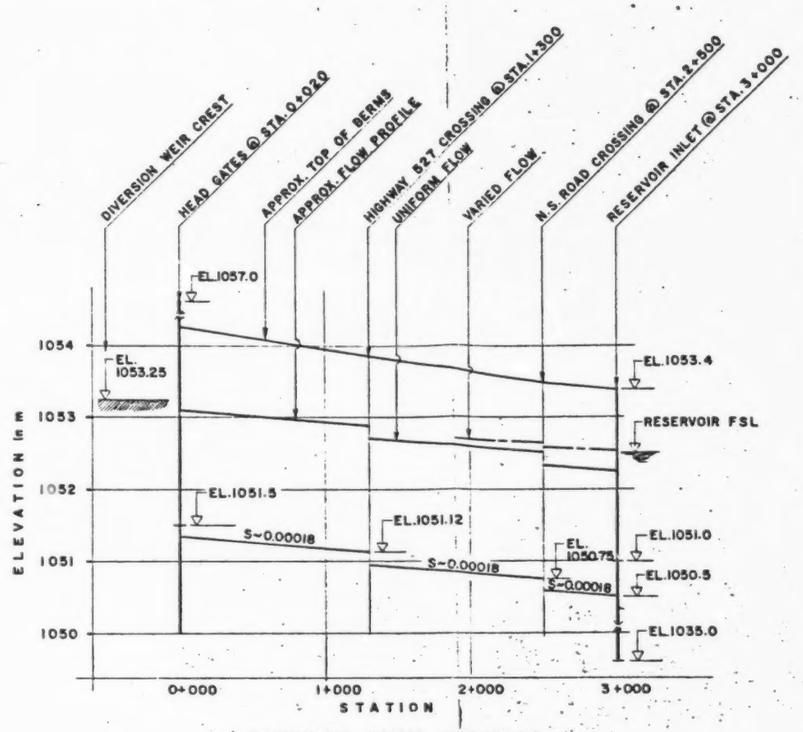
WILLOW CREEK PROJECT
PINE COULEE RESERVOIR - OFFSTREAM STORAGE

OUTLET WORKS

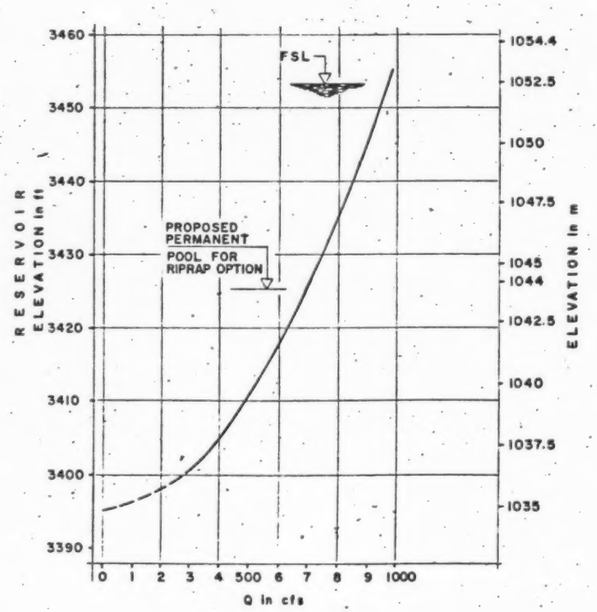
SCALE AS SHOWN	SHEET 8 OF 9
DATE AUGUST, 1985	DWG No. PICOR - E85-55



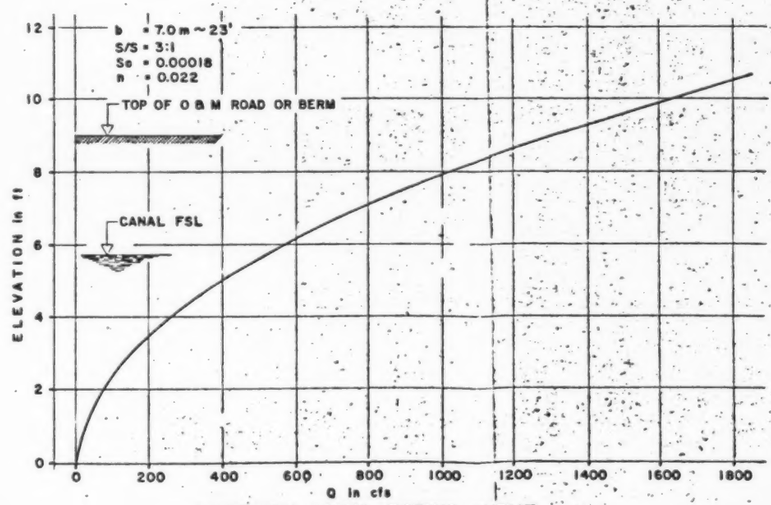
STORAGE CAPACITY CURVE



DIVERSION CANAL PROFILES



OUTLET WORKS
RATING CURVE-DIVERSION MODE



DIVERSION CANAL RATING CURVE
FOR UNIFORM FLOW CASE ONLY

MARK	NATURE OF REVISION	DATE	ENG.	DWN.
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Alberta ENVIRONMENT — DESIGN AND CONSTRUCTION DIVISION

SUBMITTED	DESIGNED .....
DATE	CHECKED .....
APPROVED	DRAWN .....
DATE	CHECKED .....

WILLOW CREEK PROJECT
PINE COULEE RESERVOIR-OFFSTREAM STORAGE

DESIGN ASSUMPTIONS

SCALE	SHEET 9 OF 9
DATE NOVEMBER, 1985	DWG No PICOR-E85-38